WHAT IS CLAIMED IS:

1. A method of determining a potential at a surface of a sample, the method comprising:

immersing the sample in a polar solution so as to form a potential gradient at the surface;

positioning a tip of a probe of a scanning probe microscope in the solution a perpendicular distance from the surface; and

measuring a potential of the probe.

2. The method of Claim 1, further comprising the step of providing relative scanning movement between the sample and the probe.

3. The method of Claim 2 further comprising the step of generating a feedback signal based on the potential.

4. The method of Claim 3, further comprising the step of moving the tip generally orthogonal to the surface in response to the feedback signal so as to maintain a generally constant separation between the two.

5. The method of Claim 4, further including the step of recording an X-Y scan position associated with the feedback signal so as to facilitate generation of a topography map of the surface of the sample.

6. The method of Claim 1, wherein the potential is a potential difference between the probe and a reference.

7. The method of Claim 6, wherein the reference is the sample.

8. The method of Claim 1, further including the step of moving the tip relative to the surface so as to keep the potential difference therebetween generally constant.

9. The method of Claim 1, further including the step of controlling a potential associated with the sample.

10. The method of Claim 1, further including the step of controlling a current through the sample.

11. The method of Claim 1, further including the steps of:
moving the tip substantially perpendicularly to the surface; and
measuring the potential difference between the tip and the sample during said moving step.

12. The method of Claim 11, wherein said moving step is performed at a particular X-Y position of the surface of the sample.

13. The method of Claim 1, wherein the sample is one of a conductive material and a semi-conductive material.

14. The method of Claim 1, wherein the polar solution is one of an aqueous solution and a non-aqueous solution.

15. The method of Claim 1, wherein the polar solution is electrolytic.

16. The method of Claim 1, wherein the polar solution is a pure liquid.

17. The method of Claim 1, wherein the potential gradient is formed by an electrical double layer.

18. The method of Claim 1, further comprising the step of altering the ionic concentration of the polar solution.

19. The method of Claim 1, wherein the controlling step includes operating in an open circuit condition.

20. The method of Claim 1, further comprising the step of providing relative scanning movement between the sample and the probe while maintaining a separation between the tip and the surface generally constant.

21. A method of characterizing a sample surface, the method comprising:

determining, with a probe of a scanning probe microscope operating in an SEPM mode, a potential across a potential gradient formed at the sample surface; and

characterizing the sample with the probe of the scanning probe microscope operating in an STM mode.

22. The method of Claim 21, wherein the potential gradient is formed by an electrical double layer.

23. The method of Claim 21, further comprising the step of scanning the sample surface with the probe.

24. The method of Claim 21, further comprising the steps of:

repeating said determining and characterizing steps for a plurality of points on the sample during said scanning step;

generating an SEPM image based on said determining step;

generating an SPM image based on said characterizing step; and

comparing the SEPM and SPM image.

25. The method of Claim 24, wherein said comparing step includes subtracting the STM image from the SEPM image so as to generate a charge distribution image.

26. A scanning electrochemical potential microscope (SEPM) comprising:

a sample support that accommodates a sample immersed in a polar solution, wherein a potential gradient is formed at a surface of the sample;

a probe having a tip including a distal end disposed a perpendicular distance from the surface; and

a potential measuring device electrically coupled to said tip that measures a potential across said potential gradient.

27. The SEPM of Claim 26, further comprising a scanning actuator that provides relative scanning movement between said probe and said sample.

28. The SEPM of Claim 26, wherein said scanning actuator is a piezoelectric actuator.

29. The SEPM of Claim 26, further comprising a feedback circuit that generates a feedback signal based on said potential.

30. The SEPM of Claim 29, further comprising a Z-actuator that translates the Z-position of said tip in response to said feedback signal.

31. The SEPM of Claim 26, further comprising a Z-actuator that translates the Z-position of the tip in a spectroscopic mode.

32. The SEPM of Claim 26, further comprising a tuning device that modifies a sample potential at the sample surface.

33. The SEPM of Claim 32, wherein said tuning device is a bi-potentiostat.

34. The SEPM of Claim 26, wherein the polar solution has an associated ionic concentration, and said potential gradient is formed by an electrical double layer.

35. The SEPM of Claim 34, wherein said ionic concentration can be modified to tune the operation of the SEPM.